has quite descended below the level of that quality of work which needs the distinguishing encouragement afforded by the publication of the results obtained in the "Transactions" of any learned Society.

PICKERING'S "PHYSICAL MANIPULATION"

Elements of Physical Manipulation. By Edward C. Pickering, Phayer Professor of Physics in the Massachusetts Institute of Technology. Part I. (London: Macmillan & Co., 1874.)

TO write a satisfactory text-book for students in physical laboratories is a task beset with difficulties; and although Prof. Pickering has had the advantage of no small experience and judgment in the composition of the work the title of which is given above, we do not think that he has entirely overcome them.

There can be little doubt that oral teaching is that which is best suited to students who are beginning experimental work of any sort, and that as much may often be learnt in five minutes by seeing another perform an experiment as would be acquired in as many hours with the aid of a book alone to explain the construction and use of the apparatus; and Prof. Pickering is therefore right in aiming at supplementing rather than superseding the efforts of an instructor.

The work is divided into sections, each of which relates to one or more experiments, and comprises two parts, the first of which, entitled "Apparatus," gives a description of the instrument required, and is designed to aid the instructor in preparing the laboratory for the class, while the second, headed "Experiment," explains in detail to the student what he is to do.

The subjects treated of in the first volume, the only one at present published, are Mechanics, Sound, and Light, an arrangement that does not agree with the order in which they would probably be studied in the laboratory, as the elementary parts of heat ought certainly to be taken with mechanics; but the plan adopted has the advantage that heat and electricity, the subjects in which tables are most required for reference, will be placed together in the second volume, in which also, we presume, sets of tables will be included among the "matters of general interest to the physicist" that are promised in the preface.

Apart, however, from any detailed criticism, we must notice the important preliminary question, how far a work of this sort is likely to fulfil the object with which it is written, of enabling an instructor to superintend a larger class than he could otherwise attend to at once? The members of the class, according to the method of instruction pursued in the Massachusett's Institute, and described in the preface, are not informed precisely what experiments will be allotted to them until they enter the laboratory, and as such is the plan probably generally adopted where the number of pupils is large, it is absolutely necessary for the instructor to have at hand, either in a text-book or in manuscript, short papers on the theory of the different experiments. We do not, however, feel sure that the descriptions of apparatus and methods of performing experiments will prove so valuable as might at first sight appear probable. The instruments required for physical work are often so costly as to make constant supervision necessary over those who are not accustomed to them, and their construction is so various, at all events in minor particulars, that directions for their use which might be all that could be desired in one laboratory might be misleading in another. Another difficulty arises in describing experimental proofs of the simpler laws of Mechanics and Physics which do not require elaborate apparatus for their exhibition, as a choice has often to be made between several different methods, an account of all of which would make the text-book unwieldy in bulk, while the omission of any is apt to make it less useful in laboratories other than that for which it was originally intended. The selection of experiments of this sort must in great measure depend upon the time the pupil is able to devote to the study of physics, the objects he has in view in pursuing it, and in many cases upon his knowledge of mathematics; and we regret that Prof. Pickering seems occasionally to have chosen those which are likely to give the best numerical results, in preference to others which, depending more upon skill, are not indeed so suitable for the exact verifications of physical laws, but have a greater educational value in improving the powers of observation.

The method selected, for instance, for illustrating the laws of falling bodies is that of suspending a ball to a spring, which, when the connecting thread is severed and the ball allowed to fall, completes a galvanic circuit in which a chronograph is included, and which is again broken by the impact of the ball on a plate placed below to receive it. This method is well adapted to show the relation between the time of falling from rest and the distance traversed; but Attwood's machine, of which no account is given, illustrates the fundamental laws of dynamics much more completely, is capable, if fitted with proper electric arrangements, of giving extremely good results, and is better suited for use by the pupil, as in our opinion all such instruments ought at first to be used, with some means of measuring time, such as the stop-watch, water-clock, or metronome, dependent upon skill, and not upon a purely mechanical arrangement.

Some of the experiments described are avowedly given as a preparation to those who may have to give lectures on physics, and others are, we presume, inserted with the same intention, as it would hardly be necessary for those possessing that "moderate familiarity with the general principles of physics" which "the class is supposed to have previously attained" to spend time over the experimental proofs given of the laws of the composition of forces, or the equality of the angles of incidence and reflection.

The earlier pages of the book are devoted to general remarks on physical measurements, and on methods of working up the results of experiments, and they will prove very useful.

The knowledge of mathematics assumed throughout is small, and in several instances the line has in this respect been drawn too tightly, no account being given of the method of determining the coefficient of torsion by means of the torsion pendulum, or of the determination of gravity by the reversible pendulum, probably on account of the small amount of rigid dynamics required in these problems.

In a book, however, which must necessarily be intended for use by pupils of very different attainments, it would be difficult to avoid criticisms of this kind, and we think the experiments on the whole judiciously selected and clearly explained. We shall look with interest for the appearance of the second volume, and when finished "Physical Manipulation" will no doubt be considered the best and most complete text-book on the subjects of which it treats. A. W. R.

OUR BOOK SHELF

Mineralogy. By F. Rutley, F.G.S. (Murby's Text Books.)

MR. RUTLEY'S little treatise on mineralogy has the merit of expressing in a clear and simple form the facts that are most wanted to be known by the general student of a science for which a small elementary English book is needed. The descriptions are concise, and the selection of the matter under each mineral generally good. Mr. Rutley, furthermore, gives some fifty pages of preliminary matter, which, though not always put in the most intelligible form, yet embodies a considerable amount of useful technical teaching in regard to the physical properties of minerals. Mr. Rutley even enters, and very rightly does so, on the subject of optical characters. But in these pages, as in the page on thermo-electricity, the author does not seem to have carefully revised what he wrote, or he would not have followed other authors in speaking of boracite as a uniaxal crystal, and would hardly have classed the dispersion of light by a diamond with the play of colour exhibited by an opal. Nor is an optic axis correctly described as the only direction by looking along which the doubly refracted images of a spot can be got to coincide, as Mr. Rutley will see if he looks at the spot through two opposite faces of the hexagonal prism of a calcite crystal. He ingeniously endeavours to indicate the nature of the faces of his crystals by a sort of heraldic hatching and marking. The use of small letters always indicating the character of the faces, as in Des Cloizeaux and other French treatises, might have done this usefully; Mr. Rutley's puzzling figures will probably only serve to scare away the English student, who needs every allurement to the study of the neglected science of crystallography—a science neglected merely because the rudiments of geometry and trigonometry are not made a necessary part of every scientific student's education. And it is a significant circumstance in connection with this neglect of scientific crystallography, that the geometrical methods and simple notation introduced forty years ago by our distinguished fellow-countryman, the first living crystallographer, Prof. Miller, are, we believe, untaught in any single lecture-room in London. Is England to be the last country to adopt a system made European by Sénarmont, Sella, Beer, and Grailich, and which is fast overcoming even in Germany itself a natural prejudice in favour of the more unwieldy, though in its time useful and ingenious, notation of the great Leipsig Professor?

Sanitary Arrangements for Dwellings, intended for the use of Officers of Health, Architects, Builders, and Householders. By William Eassie, C.E., &c. (Smith, Elder and Co. 1874.)

THIS volume gives, in a collected form, a series of papers published originally in the *British Medical Journal*. Its object, the author states, is to give "an account of the most ordinary sanitary defects in dwelling-houses and public institutions, in respect to drainage, water-supply, ventilation, warming, and lighting;" and "to set forth,' what he believes, "the most simple and effective means of *preventing* or *remedying* such defects." He thinks it necessary to say further:—"The purpose of this small work is to point out, in the plainest language, what ought to be done to render ancient and modern houses healthy. I will eschew all extraneous matter, as much as possible, and will not fall into the common practice, better honoured in the breach than the observance, of heading the chapters, or interlarding the matter, with lines from the poets." It is but due to the author to say that he has faithfully avoided this tendency "to drop into poetry" on the subject of house-drains, sewers, &c.; on the plainness of the language, however, we cannot speak very highly. Many householders, it is to be feared, will find some difficulty in recognising an S-shaped pipe under the name of a "sigmoid"; or in appreciating the beauty of a description in which the overflow sewage from a cesspool is said to "debouch into the fields."

The greater part of the book is occupied with a description of the various sanitary appliances for buildings which have from time to time been proposed, or which have been brought into actual use: such as drain-pipes, of which twenty-two different kinds are figured and described; traps, of which thirty-six are given; fire-grates and stoves, &c. In many places, indeed, it reminds us of nothing so much as a manufacturer's or tradesman's catalogue. On the whole, however, this work contains much useful information and many excellent suggestions. On the subject of house-drainage, we are glad to see that Mr. Eassie has adopted and advocates the principle of leading all house-drains into one collecting drain, outside the house if possible, and placing in this main drain an efficient trap, properly ventilated, so as to prevent any of the sewer gases finding their way into the house through the drains or pipes.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Robert Brown and Sprengel

IN the notice of Mr. Darwin (vol. x. p. 80, bottom of 2nd col.) a mishap has somehow occurred which blunts the point intended to be made prominent and renders the statement untrue. I supposed that I had written "*And* we know from another source that he (Mr. Brown) looked upon Sprengel's ideas as *by no means* fantastic. Yet instead," &c. The object was to show how very near Mr. Brown came to reaching the principle that Nature abhors close-fertilisation in plants, and yet did not reach it at all. The authority for the statement I wished to make will be found in a footnote in Mr. Darwin's book on the "Fertilisation of Orchids," p. 340. ASA GRAY

Cambridge, Mass., June 19

On the Physical Action taking place at the Mouth of Organ-pipes

THE most interesting, and perhaps the most important, fact disclosed in the experimental study of the organ-pipe on the air-reed theory is this—that the aeroplastic reed has a law of its own, unique amongst the phenomena heretofore observed in musical vibrations. It may be stated thus—*As its arcs of vibration are less, its speed is greater.* All our knowledge of rods and strings, of plates and membranes, would lead us to expect the usual manifestation of the law of isochronism, that in the air-reed considered as a free rod fixed at one end and vibrating transversely, the law would be observed, "though the amplitude may vary, the times of vibration will be the same." Yet here we meet with its absolute reversal, viz.—*the times vary with the amplitude.* This information does not rest on theory; every eye may verify it. A principle so strange, when first its action was observed, might well lead to disbelief in one's senses, although the mind had by its reasonings led up to the fact and sought for it as the one thing needed to give consistency to theory and make it a perfect whole. Familiar as the air-reed had been to me, the one secret had been hidden from my eyes; seeing, they saw not. Faith in the known mode of activity of the transversely